



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

AMERICAN STATISTICAL ASSOCIATION.

NEW SERIES, No. 6.

JUNE, 1889.

Read before the AMERICAN STATISTICAL ASSOCIATION, April 25, 1889.

AMERICAN RAILROAD STATISTICS.

BY PROF. ARTHUR T. HADLEY.

HISTORY.

1. The oldest, and for many years almost the only, source of statistical information consists of the reports of the railroads themselves.

From the very first such reports were annually made by the directors to the stockholders. If properly arranged they furnish a large part of the statistical information which interests the general public. They should contain an account of the permanent expenditures on the property, and the means by which they are met, whether stock, bond, floating debt, or surplus earnings. This forms the General Balance Sheet. To this should be appended a description of some of the physical characteristics of the road,—length of line, bridges, buildings, and equipment. In addition to this, and distinct from it, is the income account for the year, giving a classified summary of receipts and expenditures, to which is appended an account of the work done, the miles run by trains of various descriptions, the amount of freight and passenger transportation. The stockholders must have these facts fully presented to them in order to know the

condition of their own property; and any presentation which can properly satisfy the stockholders gives most of the information which the public requires.

Unfortunately, few of the earlier railroad reports were made out in this form. At the outset the directors themselves did not know enough to do so. The complete separation of capital and revenue account was comparatively new. Few manufacturers employed it to anything like the extent in use at present. As a consequence, the balance sheet of a sheet of a railroad was arranged like that of a bank. Income and property balances were jumbled into one mass. The result was hopeless confusion.

Even when they had begun to learn how railroad accounts should be arranged many of the directors continued to follow the old practice. They did not regard it as desirable to present the facts fully and clearly. It does not necessarily follow that they were dishonest. They had an exaggerated idea, in many cases, of the importance of business secrets. They conceived that more harm was done by making business conditions known to the public than by concealing them from the stockholders. This was a wholly wrong view; but it was held by many people who should have known better. If we add to these cases the number of those railroads which were dishonestly managed, and where concealment was sought with fraudulent purposes, we should see how incomplete was the information to be expected from the voluntary action of the directors themselves. A few companies gave good reports, the majority gave bad ones.

Apart from the question of goodness or badness of individual reports, the diversity in minor details rendered them nearly useless for general statistics. One railroad gave its information in one form, another in another; any attempt to summarize the two was out of the question. Twenty-one years ago Mr. Henry V. Poor published the first number of his "Manual," which has since been a standard book of reference. For more than ten years he could do little more

than to publish the reports of the several companies with but slight attempt at any summary. He could give general statistics of mileage, perhaps with some approach to accuracy, and, with less confidence, a few leading items with regard to capital and earnings, which were common to all reports. But any detailed description of work done was wholly impossible.

2. The next important source of information is found in the reports of state officials. New York,¹ by Act of 1849, took the lead in this matter. Beginning with 1850, we have pretty complete transportation reports of New York railroads to the State Engineer. The requirements were good, decidedly ahead of their time; their fulfillment was, of course, imperfect. Efforts were made to extend the powers of the state authorities. A proposal for a commission, made by the State Engineer in the report for 1854, is fifteen years in advance of what was finally accomplished in Massachusetts. But the crisis of 1857, and then the war, turned men's minds in another direction. A few states followed the example of New York, but without important statistical results. In principle this may have marked a slight advance over that state of things where we had to rely on voluntary reports of directors to stockholders. In practice the difference amounted to very little. The State Engineer had neither the time nor the powers to inaugurate any real reform.

The rise of the system of railroad commissions gave an opportunity for more effective work. As early as 1871 the Massachusetts Commission turned its special attention to the subject of accounts. It made haste slowly, consulting with the officials of the different companies. The classification of earnings gave no trouble. The account of work done was brought into such shape that all the companies reported it on a nearly uniform system, without much delay. But the

¹ Massachusetts Act of 1846 required returns, but did not involve their compilation. Partial compilation was begun in 1849.

arrangement and subdivision of expenses was a much more complicated problem, and it was a number of years before anything like uniformity could be obtained in this respect.

The efforts of the Massachusetts Commissioners met a hearty response from other states, not merely from the Commissioners themselves, but from far-sighted railroad men, who saw that the old system of secrecy was an evil, and true publicity a protection to legitimate interests. A preliminary convention to secure uniformity of returns was held in 1877; a more important one at Saratoga in 1879, which agreed upon certain points with regard to the classification of operating expenses. This arrangement, known as the Saratoga classification, has been at the basis of all subsequent railroad statistics; but it was so far indefinite as to leave room for a great deal of divergence in practice, even by those who conformed to its general requirements.

Totally apart from the question of any such divergence, state statistics of railroad operation are not particularly good. State lines form an artificial boundary which railroad systems pass and repass at a number of different points. It is possible to ascertain the mileage within a given state; it is not possible to ascertain with anything like the same accuracy either the receipts or expenses belonging to that state. Any such apportionment must be wholly arbitrary. Sometimes it is not made at all; generally it is made in such a manner as to be useless. Most of the inferences with regard to the volume of traffic which could be obtained from the state reports, as such, would be positively misleading. If we had to choose between a set of state reports thus and a set of reports of different railroad companies arranged on a uniform system, the latter would be far more useful. The separate railroad systems have far more unity and independence than the separate state lines. In the one case the division is organic; in the other it is accidental. The best statistical work done by the state commissions was first in familiarizing the railroad men with the idea of pub-

licity of accounts, and next in laying down a few of the general principles by which such publicity can best be secured. When the Interstate Commission has brought its statistical work into more advanced shape, it is most sincerely to be hoped that the state statistics will be treated as subsidiary. Recent events show a tendency in this direction. A convention of state railroad commissioners, held at Washington last March, decided to conform their respective accounts, in all essential features, to the requirements of the form prescribed by the Interstate Commissioners.

3. The first systematic collection of national railroad statistics is to be found in the fourth volume of the United States Census of 1880. This contains—

- I. The income account (not fully itemized) of the railroads of the country for the fiscal year 1880.
- II. The general balance-sheet (permanent assets and liabilities) in detail.
- III. Financial results of traffic operations,—itemized earnings and expenses.
- IV. Physical description of traffic operations,—not quite complete.
- V. Analysis of character of freight.
- VI. Description of equipment and employees.
- VII. Statistics of accidents,—not complete, owing to imperfect record of the companies themselves.
- VIII. History of construction.
- IX-XII. Physical statistics of track.

Supplementary tables give more detailed analysis of funded debt, land grants, outstanding contracts, etc., but by no means wholly complete exhibits.

On the whole, the transportation work in the Census is wonderfully well done. In spite of the difficulties under which the authorities labored, owing to the newness of the work, the result is fully as good, if not better, than that which has been obtained in the same field in any other country; and is, in certain essential features, better than

what the Interstate Commerce Commission, with eight years' subsequent experience to guide it, is now trying to do.

The appearance of the United States Census, and the familiarity of the officials of the different roads with some of its leading requirements, enabled Henry V. Poor, in 1882, for the first time to publish certain general statistics of work done. These he has continued to give from year to year, in the face of a good deal of difficulty. Within two years past the Interstate Commission has addressed itself to the same work, with facilities, of course, far superior to those of any private individual. Early in 1888 a provisional form was issued for the railroad men to discuss and criticise. After some delay the final or definite form of report was issued in July. The information asked was so detailed that it was impossible to obtain anything like complete statistics during the first year, and the original report of the statistician, Prof. Henry C. Adams, is occupied more with general considerations than with definite or tangible results.

PRINCIPLES INVOLVED.

4. We may divide railroad statistics roughly into those which are chiefly economic and those which are chiefly physical in their character. Under the latter head come statistics with regard to grades and curves, with regard to material used in construction, and with regard to accidents. Under the former head come the accounts of finance and business operations. It is to these that we shall devote chief attention.

A railroad differs from most other lines of business in the sharp separation between permanent and current expenditures. Every good system of railroad statistics takes full account of this, giving a description and financial condition of the property on the one hand as distinct from the operations on the other. The chief items of information under the former head are, first, length of line, length of track, and amount of equipment in various forms with the relation

of these items to the area and population ; second, cost of these various items as well as other accessory forms of property incidental to the operation of the road ; third, means by which this cost has been met. This part of the subject is well understood. Every one agrees, for the most part, as to the questions which ought to be asked ; the only difficulty is in answering them.

The easiest question to ask, and the hardest to answer, is, How are we to estimate the real capital of a road? It is well known that a large part of the stock is water, that is, does not represent any money actually paid in. On the other hand, from time to time, it often happens that repairs have been paid for out of earnings, and are not charged to the general balance sheet at all. It is hard to tell what is the amount of these errors, and how far they balance each other.²

Another disputed point relates to the current assets and liabilities of a company. No road can keep its bills wholly paid up or wholly collected. The consequence is that it has some outstanding cash assets and some current liabilities. How far shall the latter be included in the capital account of a road? The Interstate Commissioners have tried to settle the matter by having each road report its current liability balance, which hardly seems a satisfactory solution of the problem.

5. The difficulties in arranging the schedules under the current account of operations are far greater. Let us try to explain a few of the points involved, and then see how the different systems adopted meet the requirements of the case.

Among the current expenditures of a railroad there are always a number of purely financial ones, such as interest and rentals, which do not form part of the operating expenses in the narrower sense. These form, in all systems of railroad

² There is a possibility of mistake in attempting to compare mileage with area or population, because it is so easy to confuse the location of the reporting office with the location of the road itself, an error which has actually been made in the first of the statistical reports of the Interstate Commerce Commission.

accounting, a class by themselves, known under the general head of fixed charges.

There are, in the second place, a number of general expenses for salaries for general officers, outside agencies and advertising, legal service, and a variety of other things which attach to the operation of the road, as a whole rather than any particular part of it. These form a second class.

There are expenditures for repairs in all conceivable forms, classified under the head of maintenance, and usually divided into maintenance of way and maintenance of equipment.

Finally, there are the direct and immediate expenses of transportation or of handling the traffic, which may be subdivided into two distinct heads, train service and supplies on the one hand, and station service and supplies on the other.

These distinctions are more important than would appear at first sight. It is characteristic of railroad economy that some of the expenses, like those of train and station service, vary in proportion to the traffic, while others are very far from doing so. An increase in the traffic does not necessarily bring an increase in the amount of general expenses, or even in the amount of maintenance charges, the latter being in many instances due to the weather rather than to wear. It is in the highest degree desirable that this distinction should be recognized in the statistics as far as possible. It is hardly too much to say that the merits of various arrangements of operating expenses depend largely upon the recognition of this distinction. The Saratoga classification made little attempt at arrangement of this kind. It simply divided the items under some twenty different heads, and left the different reports free to group these heads as they might choose. The United States Census went a step farther, and a long step in the right direction. Besides the distinction of fixed charges from operating expenses in the narrower sense, which every one recognizes, it made a farther separation of maintenance of way and maintenance of equip-

ment, but grouped general expenses, train service and station service under the one comprehensive head of "transportation." This was an error, but being an error of omission was not a very serious one. It simply requires the statistician, when he wants to draw conclusions on certain vital points, to add up various separate items for himself instead of having the work done for him in advance.

Some of the State Commissions have adopted substantially the classification of the United States Census. Others have gone farther, and have separated general expenses from transportation expenses, in the narrower sense. On the other hand, a few of the authorities and many of the railroads prefer a radically different division of the accounts, not making maintenance of equipment a separate head, but grouping locomotive repairs with fuel and locomotive wages under the general head of locomotive service, while car repairs were arranged under the head of train service in the same way. This practice has something to be said in its favor, especially from the point of view of railroad economy, but for the purposes of the political student it is not so good as the other; and we may congratulate ourselves that the Interstate Commission did not adopt it, but preferred the New York plan, that is to say, substantially the one outlined at the beginning of this section.

Another thing done by the Interstate Commerce Commission was not nearly so good. In their blank forms they attempt to separate all railroad expenses by an arbitrary apportionment to freight and passenger business.

At first sight this seems natural enough. Every one wants to know what it costs a railroad to transport a passenger or a ton of freight a given distance. The Commissioners so much desired this information that they have lost sight of the fact that it is the nature of things not to be had, and that what they are getting is a false and arbitrary return which is worse than none at all. Their letter of instructions shows in an indirect way the fallacy involved. They say

that in dividing expenses between freight and passenger business, those which are naturally divisible should be classed under the respective heads; those which are "not naturally divisible" should be apportioned in the ratio of the passenger and freight train mileage. This is purely arbitrary. If they are not naturally divisible why should they be artificially divided? How does the Commission know that a freight train mile should be equal to a passenger train mile in the amount of maintenance of buildings which it involves? How do they know that each should share equally in the proportion of the salary of the president chargeable to it? It is one of those cases where an attempt to divide is arbitrary in its resting on a series of unproved assumptions, and giving, in many instances, at any rate, fallacious results. Suppose that a given line of freight could not pay its share of the repairs of fences. Ought the railroad to discard such freight when it will contribute to the profits of the road without causing any additional damage to the property of the line from infuriated cows?

The expenses for train and station service can be apportioned and distributed. The expenses of passenger trains, and of agents at passenger stations, are directly chargeable to passenger service, and an increase in the amount of business done will bring a more or less direct increase in these expenses. The same may be said of the corresponding expenditures with regard to freight. To a considerable extent this is true of car repairs of various sorts. On the other hand, the general expense of maintenance of way and the interest do not increase with the development of new traffic. Suppose it costs fifty cents per train mile to carry a hundred passengers or two hundred tons of freight. The direct expense of carrying such passenger is about half a cent a mile. The direct expense of carrying the freight is about one quarter of a cent per ton mile. Each of these things represents something tangible. Any business obtained at rates higher than this, provided it could be obtained on no

other terms, represents so much gain to the railroad. The fact that it appears to be done at less than the average cost of doing the whole business does not prevent its being good policy. The fact is, that the average cost of doing the whole business, itemized in the way that the Commission desires to see it done, is in the highest degree misleading. This is the most serious fault in the arrangement proposed by the Interstate Commerce Commission, and we cannot help hoping that it will be modified in the course of time.

There is another system of division of expenses into movement and terminal charge. This has not been extensively adopted by the statisticians of this country; but the courts, both here and in England, have often tried to use it. The underlying idea is this: The expenses of handling any kind of traffic are partly independent of the distance and partly proportionate to it. Station expenses belong to the former class; train and track expenses to the latter. The theory is that the tariff for any distance should consist of a fixed terminal, *plus* a mileage rate proportionate to the distance. This sounds plausible; but it involves the same fallacy as the arbitrary distribution of freight and passenger expenses. Many of the things which are charged as terminals do not attach to any particular piece of traffic, but to the business as a whole.

This matter is so important statistically, and so frequently misunderstood, that I shall ask your pardon for reiterating it in another form.

A railroad loads a ton of freight at a cost of a dollar. When this is once in the car it can be carried at a cost of only a quarter of a cent a mile. With the increased distance only the latter element increases proportionately. So much for the distribution of terminal and movement expenditures. Now suppose the railroad gets twice as many tons of freight. Will all expenses double? Obviously not. There is a distinction between expenses which vary with increase of traffic and those which do not, analogous to that between

terminal and movement expenses, but more fundamental and more important. The latter classification is well enough in its way; but in any good system of railroad statistics it must be made subordinate to the former.

6. In order that the figures of dollars and cents may mean anything, we must have an actual description of the work done. The statistical units of operation which are common to all roads and to all good systems of reporting in this country, are: 1. The number of tons or passengers handled; 2. The aggregate amount of transportation,—ton or passenger miles; 3. The aggregate amount of train movement,—freight or passenger train miles.⁸

The second of these in a rough way represents the amount of *public service done*, and is the best thing with which to compare the receipts. Thus we find that the average receipts of the railroads of the United States are 2.28 cents per passenger mile, and 1.06 cents per ton mile, while those of Prussia are 1.34 per passenger mile, and 1.34 cents per ton mile. In this way a measure of transportation service and transportation payment is obtained in something like tangible form.

On the other hand, the first and third are units of *railroad service*, and the expenses should, to a great extent, be compared with them. Thus, if we compare the station service, expenses of freight and passengers, with the number of tons or passengers handled, we obtain a criterion of station economy. If we compare the train expenses with the number of miles run by the trains of the various classes, we obtain the results of train economy on the roads in question. The attempt to compare expenses with ton mileage or passenger mileage is simply a matter of convenience as furnishing the best common measure for train and station service,

⁸ The first of these units requires no explanation. The second is a little more complicated. The annual mileage is obtained by multiplying the weight of each consignment by the distance hauled, and adding together all the products. Passenger mileage and train mileage are obtained in a similar manner, except that no allowance is made for differences in weight in computing them.

though inaccurate when applied to either of them separately.

The maintenance and general expenses, as a criterion of general economy, should be compared, not with the operations, but with the track mileage. A mile of track, to be kept in a good standard of usefulness, ought to require a certain amount of track-watchman's services, which will be needed, whether ten trains pass a day, or fifteen. Only in case of extraordinary changes in traffic should these items vary. The account of expenses on a given road is not completely or accurately presented by lumping everything in one sum, but by grouping the general expenses into one head, and the direct or distributed ones into another. We may thus say, with considerable approach to accuracy, that the ordinary expenses on the railroads of the United States is from three thousand to four thousand dollars a mile, *plus* forty to sixty cents a train mile, and the cases outside of these rather narrow limits will be few in number. But if we attempt to say that the average cost of handling a ton of freight is one cent a mile, we are dealing with a set of facts whose variations are so great as to render a generalization wholly useless. Under different amounts of traffic, roads which are otherwise alike may find a variation in cost of 400 per cent. It is obvious that it is in the highest degree desirable so to arrange our statistics as to guard against this danger.

In another year I hope to be able to present figures analyzed according to the principles here set forth. The present time is not a good one for the purpose. The United States census, which furnished an excellent basis in its time, deals with past history. The State Reports are just being superseded; the Interstate figures are still highly incomplete. It would be a waste of time and ink to do today what must be entirely set aside a few months hence.